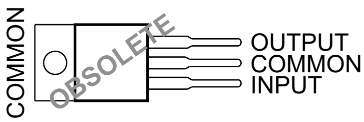
FIXED POSITIVE VOLTAGE REGULATORS

Check for Samples: µA7800 SERIES

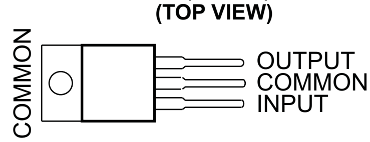
FEATURES

- **3-Terminal Regulators**
- **Available in fixed 5V/8V/10V/12V/15V/24V options**
- **Output Current up to 1.5 A**
- **Internal Thermal-Overload Protection**
- **High Power-Dissipation Capability**
- **Internal Short-Circuit Current Limiting**
- **Output Transistor Safe-Area Compensation**

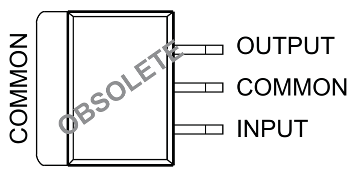
KC (TO-220) PACKAGE
(TOP VIEW)



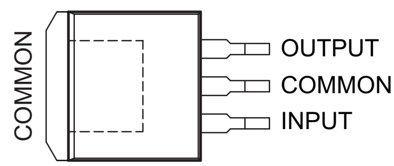
KCS OR KCT (TO-220) PACKAGE
(TOP VIEW)



KTE (PowerFLEX™) PACKAGE
(TOP VIEW)



KTT (TO-263) PACKAGE
(TOP VIEW)



DESCRIPTION/ORDERING INFORMATION

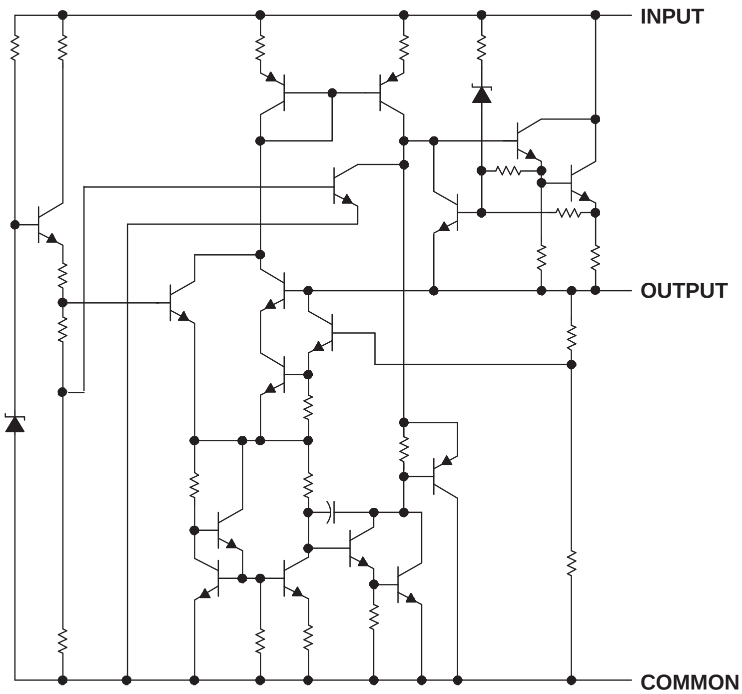
This series of fixed-voltage integrated-circuit voltage regulators is designed for a wide range of applications. These applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation. Each of these regulators can deliver up to 1.5 A of output current. The internal current-limiting and thermal-shutdown features of these regulators essentially make them immune to overload. In addition to use as fixed-voltage regulators, these devices can be used with external components to obtain adjustable output voltages and currents, and also can be used as the power-pass element in precision regulators.

ORDERING INFORMATION[1]

T_J	$V_{O(NOM)}$	PACKAGE[2]		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 125°C	5 V	TO-220, short shoulder – KCS	Tube of 50	UA7805CKCS	UA7805C
		TO-220, single gauge – KCT	Tube of 50	UA7805CKCT	UA7805C
		TO-263 – KTT	Reel of 500	UA7805CKTTR	UA7805C
		PowerFLEX™ – KTE		OBSOLETE	OBSOLETE
		TO-220 – KC		OBSOLETE	OBSOLETE
	8 V	TO-220, short shoulder – KCS	Tube of 50	UA7808CKCS	UA7808C
		TO-220, single gauge – KCT	Tube of 50	UA7808CKCT	UA7808C
		TO-263 – KTT	Reel of 500	UA7808CKTTR	UA7808C
		PowerFLEX – KTE		OBSOLETE	OBSOLETE
		TO-220 – KC		OBSOLETE	OBSOLETE
	10 V	TO-220, short shoulder – KCS	Tube of 50	UA7810CKCS	UA7810C
		TO-263 – KTT	Reel of 500	UA7810CKTTR	UA7810C
		PowerFLEX – KTE		OBSOLETE	OBSOLETE
		TO-220 – KC		OBSOLETE	OBSOLETE
	12 V	TO-220, short shoulder – KCS	Tube of 50	UA7812CKCS	UA7812C
		TO-220, single gauge – KCT	Tube of 50	UA7812CKCT	UA7812C
		TO-263 – KTT	Reel of 500	UA7812CKTTR	UA7812C
		PowerFLEX – KTE		OBSOLETE	OBSOLETE
		TO-220 – KC		OBSOLETE	OBSOLETE
	15 V	TO-220, short shoulder – KCS	Tube of 50	UA7815CKCS	UA7815C
		TO-220, single gauge – KCT	Tube of 50	UA7815CKCT	UA7815C
		TO-263 – KTT	Reel of 500	UA7815CKTTR	UA7815C
		PowerFLEX – KTE		OBSOLETE	OBSOLETE
		TO-220 – KC		OBSOLETE	OBSOLETE
	24 V	TO-220, short shoulder – KCS	Tube of 50	UA7824CKCS	UA7824C
		TO-263 – KTT	Reel of 500	UA7824CKTTR	UA7824C
		PowerFLEX – KTE		OBSOLETE	OBSOLETE
		TO-220 – KC		OBSOLETE	OBSOLETE

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.
(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.

Figure 1. SCHEMATIC



Absolute Maximum Ratings(1)

over virtual junction temperature range (unless otherwise noted)

			MIN	MAX	UNIT
V_I	Input voltage	µA7824C		40	V
		All others		35	
T_J	Operating virtual junction temperature			150	°C
	Lead temperature	1,6 mm (1/16 in) from case for 10 s		260	°C
T_{stg}	Storage temperature range		–65	150	°C

(1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Package Thermal Data(1)

PACKAGE	BOARD	θ_{JA}	θ_{JC}	θ_{JP} (2)
PowerFLEX (KTE) – OBSOLETE	High K, JESD 51-5	23°C/W	3°C/W	2.7°C/W
TO-220 (KCS), (KCT) (KC – OBSOLETE)	High K, JESD 51-5	19°C/W	17°C/W	3°C/W
TO-263 (KTT)	High K, JESD 51-5	25.3°C/W	18°C/W	1.94°C/W

(1) Maximum power dissipation is a function of $T_{J(max)}$, θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_{J(max)} – T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
(2) For packages with exposed thermal pads, such as QFN, PowerPAD™, or PowerFLEX, θ_{JP} is defined as the thermal resistance between the die junction and the bottom of the exposed pad.

Recommended Operating Conditions

			MIN	MAX	UNIT
V_I	Input voltage	µA7805	7	25	V
		µA7808	10.5	25	
		µA7810	12.5	28	
		µA7812	14.5	30	
		µA7815	17.5	30	
		µA7824	27	38	
I_O	Output current			1.5	A
T_J	Operating virtual junction temperature		0	125	°C

uA7805 Electrical Characteristics

at specified virtual junction temperature, V_I = 10 V, I_O = 500 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T_J (1)	µA7805C MIN	µA7805C TYP	µA7805C MAX	UNIT
Output voltage	I_O = 5 mA to 1 A, V_I = 7 V to 20 V, P_D ≤ 15 W	25°C	4.8	5	5.2	V
		0°C to 125°C	4.75		5.25	
Input voltage regulation	V_I = 7 V to 25 V	25°C		3	100	mV
	V_I = 8 V to 12 V			1	50	
Ripple rejection (2)	V_I = 8 V to 12 V, f = 120 Hz	0°C to 125°C	62	78		dB
	V_I = 8 V to 12 V, f = 120 Hz (KCT)			68		
Output voltage regulation	I_O = 5 mA to 1.5 A	25°C		15	100	mV
	I_O = 250 mA to 750 mA			5	50	
Output resistance	f = 1 kHz	0°C to 125°C		0.017		Ω
Temperature coefficient of output voltage	I_O = 5 mA	0°C to 125°C		–1.1		mV/°C
Output noise voltage	f = 10 Hz to 100 kHz	25°C		40		µV
Dropout voltage	I_O = 1 A	25°C		2		V
Bias current		25°C		4.2	8	mA
Bias current change	V_I = 7 V to 25 V	0°C to 125°C			1.3	mA
	I_O = 5 mA to 1 A				0.5	
Short-circuit output current		25°C		750		mA
Peak output current		25°C		2.2		A

(1) Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-µF capacitor across the input and a 0.1-µF capacitor across the output.
(2) This parameter is validated by design and verified during product characterization. It is not tested in production.

uA7808 Electrical Characteristics

at specified virtual junction temperature, V_I = 14 V, I_O = 500 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T_J (1)	µA7808C MIN	µA7808C TYP	µA7808C MAX	UNIT
Output voltage	I_O = 5 mA to 1 A, V_I = 10.5 V to 23 V, P_D ≤ 15 W	25°C	7.7	8	8.3	V
		0°C to 125°C	7.6		8.4	
Input voltage regulation	V_I = 10.5 V to 25 V	25°C		6	160	mV
	V_I = 11 V to 17 V			2	80	
Ripple rejection (2)	V_I = 11.5 V to 21.5 V, f = 120 Hz	0°C to 125°C	55	72		dB
	V_I = 11.5 V to 21.5 V, f = 120 Hz (KCT)			62		
Output voltage regulation	I_O = 5 mA to 1.5 A	25°C		12	160	mV
	I_O = 250 mA to 750 mA			4	80	
Output resistance	f = 1 kHz	0°C to 125°C		0.016		Ω
Temperature coefficient of output voltage	I_O = 5 mA	0°C to 125°C		–0.8		mV/°C
Output noise voltage	f = 10 Hz to 100 kHz	25°C		52		µV
Dropout voltage	I_O = 1 A	25°C		2		V
Bias current		25°C		4.3	8	mA
Bias current change	V_I = 10.5 V to 25 V	0°C to 125°C			1	mA
	I_O = 5 mA to 1 A				0.5	
Short-circuit output current		25°C		450		mA

(1) Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-µF capacitor across the input and a 0.1-µF capacitor across the output.
(2) This parameter is validated by design and verified during product characterization. It is not tested in production.

uA7808 Electrical Characteristics (continued)

at specified virtual junction temperature, V_I = 14 V, I_O = 500 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T_J (1)	µA7808C			UNIT
			MIN	TYP	MAX	
Peak output current		25°C		2.2		A

uA7810 Electrical Characteristics

at specified virtual junction temperature, V_I = 17 V, I_O = 500 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T_J (1)	µA7810C			UNIT
			MIN	TYP	MAX	
Output voltage	I_O = 5 mA to 1 A, V_I = 12.5 V to 25 V, P_D ≤ 15 W	25°C	9.6	10	10.4	V
		0°C to 125°C	9.5		10.5	
Input voltage regulation	V_I = 12.5 V to 28 V	25°C		7	200	mV
	V_I = 14 V to 20 V			2	100	
Ripple rejection (2)	V_I = 13 V to 23 V, f = 120 Hz	0°C to 125°C	55	71		dB
Output voltage regulation	I_O = 5 mA to 1.5 A	25°C		12	200	mV
	I_O = 250 mA to 750 mA			4	100	
Output resistance	f = 1 kHz	0°C to 125°C		0.018		Ω
Temperature coefficient of output voltage	I_O = 5 mA	0°C to 125°C		–1		mV/°C
Output noise voltage	f = 10 Hz to 100 kHz	25°C		70		µV
Dropout voltage	I_O = 1 A	25°C		2		V
Bias current		25°C		4.3	8	mA
Bias current change	V_I = 12.5 V to 28 V	0°C to 125°C			1	mA
	I_O = 5 mA to 1 A				0.5	
Short-circuit output current		25°C		400		mA
Peak output current		25°C		2.2		A

(1) Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-µF capacitor across the input and a 0.1-µF capacitor across the output.
(2) This parameter is validated by design and verified during product characterization. It is not tested in production.

uA7812 Electrical Characteristics

at specified virtual junction temperature, V_I = 19 V, I_O = 500 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T_J (1)	µA7812C			UNIT
			MIN	TYP	MAX	
Output voltage	I_O = 5 mA to 1 A, V_I = 14.5 V to 27 V, P_D ≤ 15 W	25°C	11.5	12	12.5	V
		0°C to 125°C	11.4		12.6	
Input voltage regulation	V_I = 14.5 V to 30 V	25°C		10	240	mV
	V_I = 16 V to 22 V			3	120	
Ripple rejection (2)	V_I = 15 V to 25 V, f = 120 Hz	0°C to 125°C	55	71		dB
	V_I = 15 V to 25 V, f = 120 Hz (KCT)			61		
Output voltage regulation	I_O = 5 mA to 1.5 A	25°C		12	240	mV
	I_O = 250 mA to 750 mA			4	120	
Output resistance	f = 1 kHz	0°C to 125°C		0.018		Ω
Temperature coefficient of output voltage	I_O = 5 mA	0°C to 125°C		–1		mV/°C
Output noise voltage	f = 10 Hz to 100 kHz	25°C		75		µV
Dropout voltage	I_O = 1 A	25°C		2		V

(1) Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-µF capacitor across the input and a 0.1-µF capacitor across the output.
(2) This parameter is validated by design and verified during product characterization. It is not tested in production.

uA7812 Electrical Characteristics (continued)

at specified virtual junction temperature, V_I = 19 V, I_O = 500 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T_J (1)	μA7812C			UNIT
			MIN	TYP	MAX	
Bias current		25°C		4.3	8	mA
Bias current change	V_I = 14.5 V to 30 V	0°C to 125°C			1	mA
	I_O = 5 mA to 1 A				0.5	
Short-circuit output current		25°C		350		mA
Peak output current		25°C		2.2		A

uA7815 Electrical Characteristics

at specified virtual junction temperature, V_I = 23 V, I_O = 500 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T_J (1)	μA7815C			UNIT
			MIN	TYP	MAX	
Output voltage	I_O = 5 mA to 1 A, V_I = 17.5 V to 30 V, P_D ≤ 15 W	25°C	14.4	15	15.6	V
		0°C to 125°C	14.25		15.75	
Input voltage regulation	V_I = 17.5 V to 30 V	25°C		11	300	mV
	V_I = 20 V to 26 V			3	150	
Ripple rejection (2)	V_I = 18.5 V to 28.5 V, f = 120 Hz	0°C to 125°C	54	70		dB
	V_I = 18.5 V to 28.5 V, f = 120 Hz (KCT)			60		
Output voltage regulation	I_O = 5 mA to 1.5 A	25°C		12	300	mV
	I_O = 250 mA to 750 mA			4	150	
Output resistance	f = 1 kHz	0°C to 125°C		0.019		Ω
Temperature coefficient of output voltage	I_O = 5 mA	0°C to 125°C		–1		mV/°C
Output noise voltage	f = 10 Hz to 100 kHz	25°C		90		μV
Dropout voltage	I_O = 1 A	25°C		2		V
Bias current		25°C		4.4	8	mA
Bias current change	V_I = 17.5 V to 30 V	0°C to 125°C			1	mA
	I_O = 5 mA to 1 A				0.5	
Short-circuit output current		25°C		230		mA
Peak output current		25°C		2.1		A

(1) Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.
(2) This parameter is validated by design and verified during product characterization. It is not tested in production.

uA7824 Electrical Characteristics

at specified virtual junction temperature, V_I = 33 V, I_O = 500 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T_J (1)	μA7824C			UNIT
			MIN	TYP	MAX	
Output voltage	I_O = 5 mA to 1 A, V_I = 27 V to 38 V, P_D ≤ 15 W	25°C	23	24	25	V
		0°C to 125°C	22.8		25.2	
Input voltage regulation	V_I = 27 V to 38 V	25°C		18	480	mV
	V_I = 30 V to 36 V			6	240	
Ripple rejection (2)	V_I = 28 V to 38 V, f = 120 Hz	0°C to 125°C	50	66		dB

(1) Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.
(2) This parameter is validated by design and verified during product characterization. It is not tested in production.

uA7824 Electrical Characteristics (continued)

at specified virtual junction temperature, V_I = 33 V, I_O = 500 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T_J [(1)]	µA7824C MIN	µA7824C TYP	µA7824C MAX	UNIT
Output voltage regulation	I_O = 5 mA to 1.5 A	25°C		12	480	mV
	I_O = 250 mA to 750 mA			4	240	
Output resistance	f = 1 kHz	0°C to 125°C		0.028		Ω
Temperature coefficient of output voltage	I_O = 5 mA	0°C to 125°C		–1.5		mV/°C
Output noise voltage	f = 10 Hz to 100 kHz	25°C		170		μV
Dropout voltage	I_O = 1 A	25°C		2		V
Bias current		25°C		4.6	8	mA
Bias current change	V_I = 27 V to 38 V	0°C to 125°C			1	mA
	I_O = 5 mA to 1 A				0.5	
Short-circuit output current		25°C		150		mA
Peak output current		25°C		2.1		A

APPLICATION INFORMATION

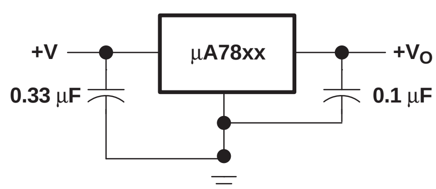


Figure 2. Fixed-Output Regulator

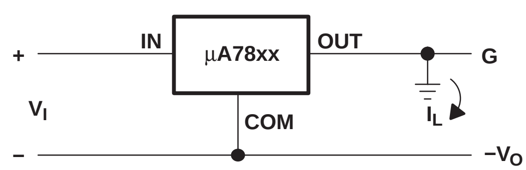
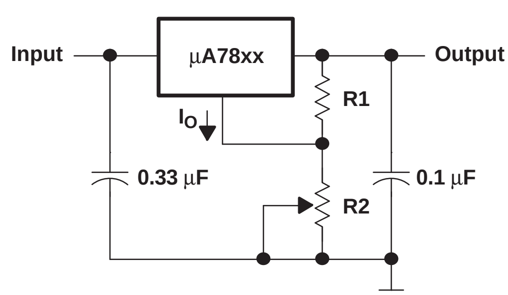


Figure 3. Positive Regulator in Negative Configuration (V_I Must Float)



A: The following formula is used when V_{xx} is the nominal output voltage (output to common) of the fixed regulator:

$$V_O = V_{xx} + \left(\frac{V_{xx}}{R1} + I_Q\right)R2$$

Figure 4. Adjustable-Output Regulator

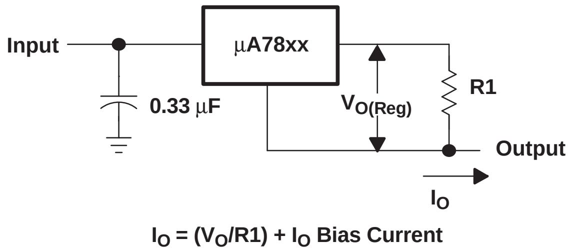


Figure 5. Current Regulator

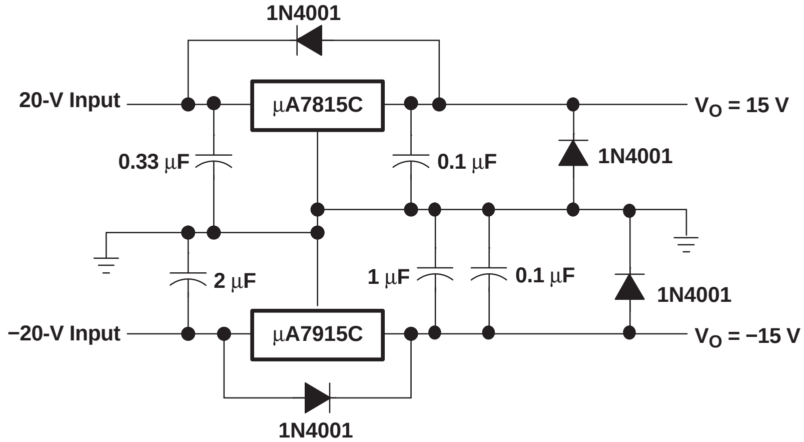


Figure 6. Regulated Dual Supply

Operation With a Load Common to a Voltage of Opposite Polarity

In many cases, a regulator powers a load that is not connected to ground but, instead, is connected to a voltage source of opposite polarity (e.g., operational amplifiers, level-shifting circuits, etc.). In these cases, a clamp diode should be connected to the regulator output as shown in Figure 7. This protects the regulator from output polarity reversals during startup and short-circuit operation.

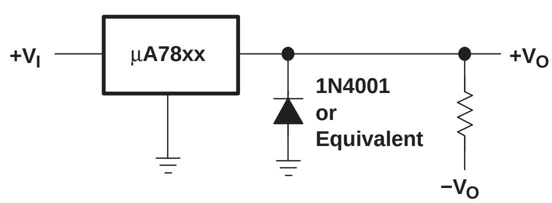


Figure 7. Output Polarity-Reversal-Protection Circuit

Reverse-Bias Protection

Occasionally, the input voltage to the regulator can collapse faster than the output voltage. This can occur, for example, when the input supply is crowbarred during an output overvoltage condition. If the output voltage is greater than approximately 7 V, the emitter-base junction of the series-pass element (internal or external) could break down and be damaged. To prevent this, a diode shunt can be used as shown in Figure 8.

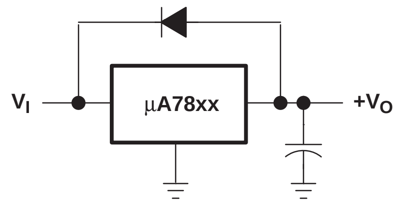


Figure 8. Reverse-Bias-Protection Circuit

REVISION HISTORY

Changes from Revision M (January 2009) to Revision N	Page
• Added KCT package and orderable part number to the ORDERING INFORMATION table.	2

Changes from Revision N (June 2012) to Revision O	Page
• Added KCT Orderable Part Numbers for 8V & 12V	2